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PRELIMINARY RESULTS OF OBSERVATIONS OF THE IONOSPHERE

EFFECT DURING THE SOLAR ECLIPSE OF 15 FEB. 1961

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IONOSPHERE EFFECT
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(Predvaritel'nyye rezul'taty nablyudeniy ionosfernogo
effekta solnechnogo zatmeniya 15.II.1961 g.)

In order to investigate the ionosphere effect from the
solar eclipse of 15 February 1961, IZMIRAN*) has organized an expe-
dition to Tbilisi (Caucasus), where the phase of the eclipse at
240 km altitude (F-layer of the ionosphere) was 0.955. The expedi-
tion set up headquarters near Kodzhori, 15 km from Tbilisi, and on
the territory of the ionosphere station of the Tbilisi University.
The apparatus of the expedition (Type C-4 ionosphere sounder) was
installed on a truck, the feeding being assured by a 19 Kw diesel
electric unit. The basic characteristics of the ionosphere sounder
were : frequency — 1 to 20 mc/s, power — 10 kw, transit time — 15 s.
pulse duration —60 μs. Reception and transmission were effected to
a single δ - antenna. The work program included : the conducting of
15-minute interval observations during the control period (from 1
to 13 February and 17 February to 1 March), of more frequent (5 min.)
observations from 14 to 16 February, and of continuous observations
during the period of the eclipse.

Because the ionosphere observations in Tbilisi were started
at first, let us present a brief account of ionosphere characteris-
tic of that region. Median values of ionospheric parameters for
February 1961, in Tbilisi(1), Simferopol' (2) and Moscow (3) are given
for the sake of comparison in Fig.1. It may be seen that the state
of the ionosphere in Simferopol' and Tbilisi differed little from one
another as an average: the diurnal minimum was well outlined in $f_0 F2$

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*) IZMIRAN, for Institute of Terrestrial Magnetism, of the Ionosphere
and Radiowave Propagation of the USSR Academy of Sciences.

at 13 - 14 00 hours local time, while totally absent in Moscow. The
absolute values of f_oF2 in Tbilisi were by about 0.5 - 1.0 mc/s
higher than in Moscow during all the days. The daily course of f_oF2
is not as smooth. The E-layer appears in Moscow and in Tbilisi during
the same morning hours, but in Tbilisi it disappears one hour later.
The mean values f_oE in Tbilisi are about by 0.3 to 0.5 mc/s higher
than in Moscow.

In going over the Tbilisi f- graphs for separate days, atten-
tion is drawn to the considerable changeability of f_oF2 during day-
time (it varies sometimes by 1 — 1.5 mc/s within 15 minutes). f_oF2
oscillations were also observed in Moscow during the same days, but
with a much lesser amplitude (0.5 - 0.7 mc/s). The Tbilisi E-region
is characterized by a frequent (13.3%) appearance of the E2-layer
at the 200 km height, while in Moscow it appears considerably more
seldom (about twice).

As an average, February is a little disturbed month, but on
15 February, the ionosphere was absolutely quiet during the solar
eclipse. The moments of beginning of the maximum phase, and of the
end of the eclipse are indicated in Figure 2 (and further), represen-
ting the f-graph for the day of the eclipse, by vertical dotted lines.
A notable lowering of layers' E, E2 and F1 critical frequencies
begun immediately with the beginning of the solar eclipse. The va-
lues of f_oE decreased by 0.9 mc/s (30%), values f_oF1 — by 1.4 mc/s (33%).
The electron density minimum in the E and F_1- layers coincides with
the maximum phase of the eclipse having taken place at 11 23,8 hours
for the 100 km altitude level, and at 11 24.2 hours for the 200 km.
altitude.

The regular variation of f_oE and f_oF1 during the time of ecli-
pse allowed a sufficiently reliable determination of the recombination
coefficients for these layers. As is well known, the variation of the
maximum electron concentration for these layer, in the assumption of
a uniform distribution of the radiation by the solar disk, is descri-
bed by the equation:

$$\frac{dN_e}{dt} = -\alpha N_e^2 + f q_0 \cos \chi,$$

where f is the function of solar disk's covering by the Moon. Inasmuch as there were no active formations on the Sun on 15 February 1961, this admission may be considered as fairly probable. Cos χ varies comparatively slowly, and it may be considered as constant during the period of eclipse.

Having computed the f values for $h = 100$ and 200 km, and having computed $N = 1.24 \ f_o^2 \cdot 10^4 \ el/cm^3$ and dN/dt according to the points of observed curves $f_o E$ and $f_o F1$, we have obtained:

for the E-layer :

$$\alpha_E = 1.5 \cdot 10^{-8} \ cm^3/sec, \quad q_o = 400 \ el/cm^3 \ sec,$$

for the F_1-layer :

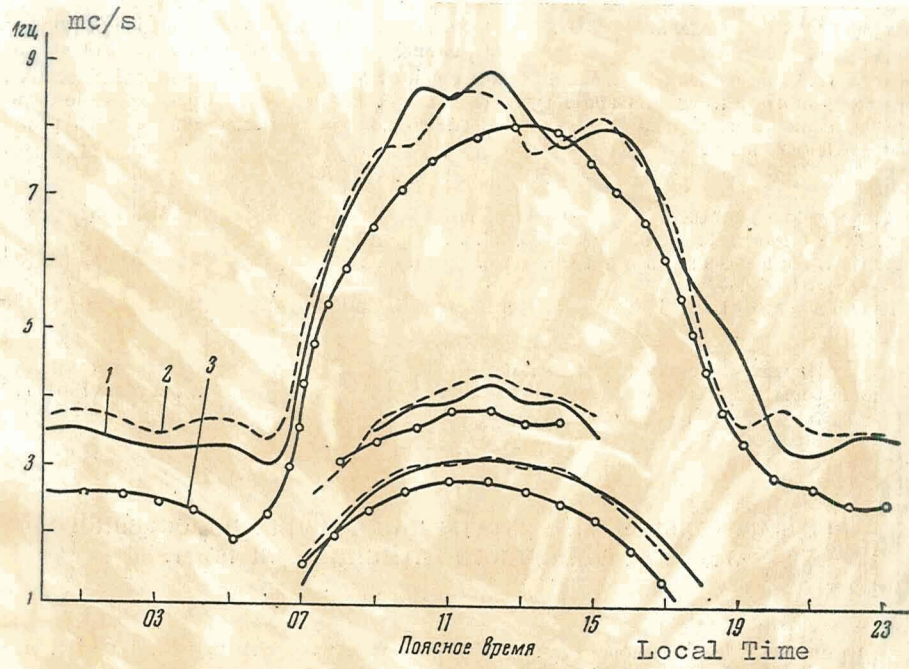$$\alpha_{F_1} = 2 \quad 10^{-8} \ cm^3/ \ sec.$$

The magnitudes α_E and α_{F_1} are in good correspondence with those obtained during the time of other solar eclipses [1].

No notable effect of the eclipse was noted in the critical frequencies of the F2- layer, as may be seen from fig. 2.

For a more detailed study of the question, Fig. 3 was drawn, where $f_o F2$ values are plotted by dots for 10 days (10 to 20 Feb.), by solid line for the eclipse day (15 Feb.1961), and by dotted line for the median values for 10 days. It may be seen from the graph that the oscillations of 15 February between 9 and 11 00 hours fully "embed" within the spread of the points. It must be noted though, that in the interval from 9 to 11 00 hours, which is close to the eclipse interval, a significant fall of $f_o F2$ was observed. However, the presence of analogus disturbances during the adjacent days having induced the diurnal maximum for the course of median values of $f_o F2$, did not allow the linking of this drop with the eclipse effect.

The obtained results do not contradict the conclusions reached in previous works. It is indicated in the book by Al'pert [2], that the magnitudes $f_o F2$ often do not vary substantially in the middle and southern latitudes during eclipses. The effect of the eclipse is

мс/ц   mc/s

Поясное время   Local Time

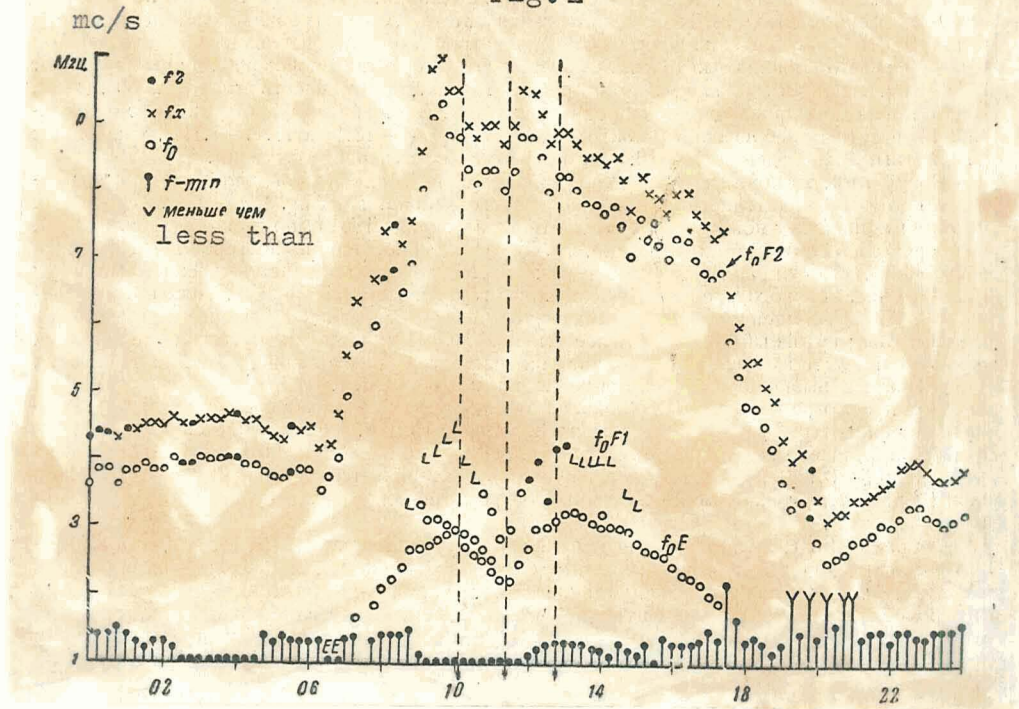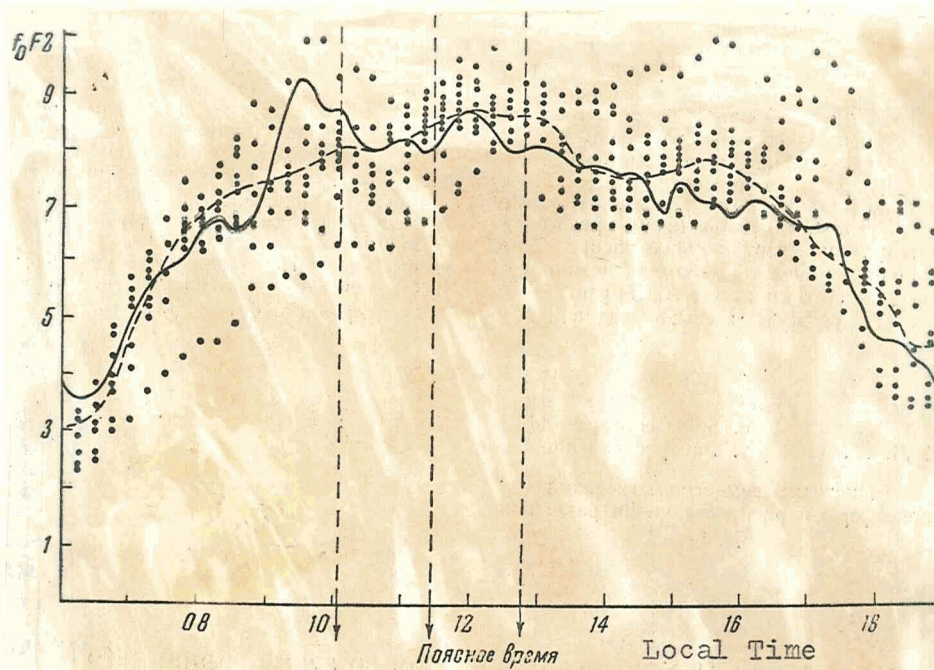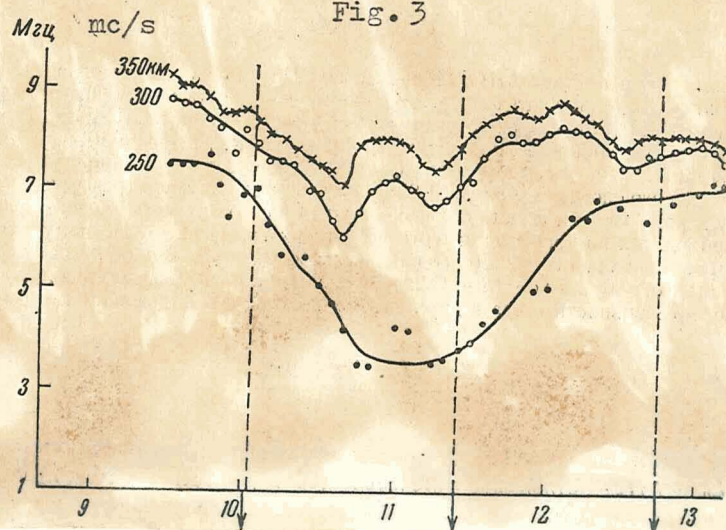Фиг. 1
Fig. 1

mc/s

Мгц

• f2
× fx
○ f0
⸙ f-min
∨ меньше чем
less than

f_0F2

f_0F1

f_0E

Fig. 2

Фиг. 3
Fig. 3

Fig. 4